WRP Technical Note VN-RS-3.1
June 1999

Design and Construction of Docks to Minimize Seagrass Impacts

PURPOSE: This technical note provides recommendations for the design and construction of dock and terminal platform structures to minimize impacts to seagrasses, and describes the construction of two experimental platforms in St. Andrew Bay, FL.

BACKGROUND: Seagrasses are widely recognized as one of the most productive and valuable habitats in the shallow marine environment. Although the area of seagrass loss associated with any individual dock is relatively small, cumulative impacts and fragmentation of seagrass beds may be significant along highly developed shorelines. With seagrass populations in decline in many areas, coastal resource managers are interested in the development of consistent, defensible guidelines to reduce additional dock-associated impacts to an already stressed resource.

The amount of available light is one of the most important factors affecting the survival, growth, and depth distribution of seagrasses. Although seagrass response to reduced lighting has been well-documented (Bulthuis 1983, Czerny and Dunton 1995, and others), experimental studies alone do not provide a basis for the development of guidelines to reduce dock shading impacts. Until recently, quantitative data to support the development of regulatory guidelines concerning the placement of docks over seagrass beds have been lacking (Loflin 1995, Burdick and Short 1999, Shafer, in press). Due to the limited data available, there has been a lack of consistency in the development and application of regulatory policy to address dock shading impacts.

GENERAL RECOMMENDATIONS FOR DOCK DESIGN: Dock height, orientation, and width have been identified as the most important factors affecting the survival of seagrass under docks (Burdick and Short 1999). Although minor factors such as plank spacing may also affect light levels beneath the docks, a recent study suggests that plank spacing is of minimal importance.[1] Species-specific differences in light requirements as well as environmental factors such as water clarity, water depth, and tidal range will also affect the ability of the plants to survive under docks. These factors should be considered in the development of guidelines to minimize dock shading impacts to seagrasses. Of these, dock height is the most critical. For fixed structures, height requirements are likely to vary from region to region depending on tidal range. Floating docks generally result in complete elimination of seagrass cover (Burdick and Short 1999), and should be avoided if possible. A north-south orientation provides a more favorable light environment for seagrass growth than an east-west orientation. Most docks are constructed perpendicular to shore, however, and property owners may have little choice concerning the orientation of the dock. Since the detrimental effects of poor orientation (east-west) may be at least partially offset by increased height (Burdick and Short 1999), increasing minimum height

[1] Unpublished data, 1999, Deborah Shafer, Research Marine Biologist, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

requirements for docks oriented in an east-west direction could enhance seagrass survival. A narrow dock allows more light to be transmitted beneath the structure, particularly in the early morning and late afternoon hours. The construction of shared dock facilities would also reduce potential cumulative impacts from multiple dock structures. This concept could be promoted through incentives to property owners.

Using a combination of modeling and empirical data collected from several sites along the Massachusetts coast, the following recommendations for dock design were developed by Burdick and Short (1999). Docks less than 2 m wide, oriented within 10 deg of north-south, and at least 3 m above the bottom will have the least impact to seagrasses. An additional 0.4 m in height should be added for each additional meter increment in width. If the alignment is more than 10 deg from north-south, the dock should be 0.2 m higher for each additional 10-deg increment. A CD-ROM entitled "Dock Design with the Environment in Mind: Minimizing Dock Impacts to Eelgrass Habitats" provides specific guidance on dock design parameters. This CD is available at a cost of $6 from the University of New Hampshire Sea Grant office at the following address: UNH Sea Grant, ATTN: Steve Adams, Highland Farm, University of New Hampshire, Durham, NH 03824.

CONSTRUCTION TECHNIQUES: The use of jet pumps during piling installation often results in large bare clearings around individual pilings which may persist for years following construction.[1] These areas ranged from 90-200 cm in diameter for docks in St. Andrew Bay, FL, and seem to be a significant source of seagrass loss associated with dock construction. Due to the close spacing of the individual pilings, these bare areas were often observed to overlap and coalesce into continuous expanses of bare sediments in the area beneath the docks. The subsequent accumulation of oyster and other shell debris around the base of the piling may limit the ability of the seagrasses to recolonize this area. Driving the piles with shallow-draft, barge-mounted equipment is recommended as the method of choice to minimize seagrass disturbance during installation. The pilings should be as far apart as practical. A spacing of at least 10-20 ft between pilings is recommended for those portions of the dock constructed over seagrasses.

REGULATORY GUIDELINES FOR DOCK CONSTRUCTION: The following guidelines are presented as an example of dock construction guidelines currently in use in the northern Florida panhandle. These guidelines were developed for single-family residential docks by an interagency team composed of representatives from the U.S. Army Engineer District, Jacksonville; the National Marine Fisheries Service (Panama City, FL); the U.S. Fish and Wildlife Service (Panama City, FL); and the Florida Department of Environmental Protection, as well as members of the private sector marine construction industry. Technical assistance was provided by the U.S. Army Engineer Waterways Experiment Station under WRAP Request Number 98-13. These guidelines were based on a literature review and limited field surveys in St. Andrew Bay and St. Joseph Bay, FL. These guidelines are being considered for use statewide by the Jacksonville District's Regulatory Division as part of the State General Permit. They

[1] Personal observation, 1999, Deborah Shafer, Research Marine Biologist, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

could be adapted for use in other coastal areas where seagrasses may be impacted by dock construction.

a. **Avoidance:** The pier shall be aligned to minimize the size of the footprint over seagrass.

b. **Orientation:** Over seagrass portions of the dock or terminal platform shall be oriented north-south to the maximum extent that is practicable.

c. **Pier height** shall be a minimum of 5 ft above mean high water (MHW) as measured from the top surface of the deck.

d. **Pier width** shall be a maximum of 4 ft. The pier may be constructed with railings. A turnaround area is allowed for piers greater than 200 ft in length. The turnaround is limited to a section of the pier no more than 10 ft in length and no more than 6 ft in width. The turnaround shall be located at the midpoint of the length of the pier.

e. **Pilings:** The spacing of the pilings through seagrass shall be a minimum of 10 ft. They shall be installed in a manner that will not result in the formation of large bare areas around each pile. Any material deposited in seagrasses around the piling should be immediately removed.

f. **Board spacing:** Gaps between deckboards shall be a minimum of ½ in.

g. **Terminal platforms:** If possible, terminal platforms shall be placed in an area devoid of seagrass. This will avoid shading impacts as well as prop scarring.

(1) Plank construction: The size of the platform shall be limited to 120 sq ft, not including catwalks. The configuration of the platform shall be a maximum of 6 ft by 20 ft, of which a maximum 4-ft-wide by a maximum 20-ft-long section shall conform to the 5-ft-height requirement. A narrow 2-ft section may be placed 3 ft above MHW to facilitate boat access. The 2-ft section shall be cantilevered.

(2) Grated deck construction: The size of the platform shall be limited to 160 sq ft, not including catwalks. The grated deck material must be approved by the Corps. The configuration of the platform shall be a maximum of 8 ft by 20 ft, of which a maximum 5-ft-wide by a maximum 20-ft-long section shall conform to the 5-ft height requirement. A narrow 3-ft section may be placed 3 ft above MHW to facilitate boat access.

h. **Boatslips:** A single, uncovered boatslip is allowed. A narrow catwalk (2-ft wide) may be added to facilitate boat maintenance along the outboard side of the boatslip and a 4-ft-wide walkway may be added along the stern end of the boatslip, provided all such walkways are elevated at least 5 ft above MHW. The terminal end is designed to accommodate a boat lift, although the boat lift is not mandatory. The 2-ft-wide catwalk shall be cantilevered from the outboard mooring pilings (spaced no closer than 10 ft apart).

EXPERIMENTAL GRID PLATFORM CONSTRUCTION: Since light is one of the most important factors affecting seagrass survival and growth, the use of alternative construction materials, such as fiberglass grid, to increase the amount of light received by the seagrasses below has been suggested as a viable mechanism to reduce loss of seagrass due to dock shading impacts. This material possesses the strength and safety characteristics necessary for dock construction and is available in a variety of opening sizes and thicknesses.

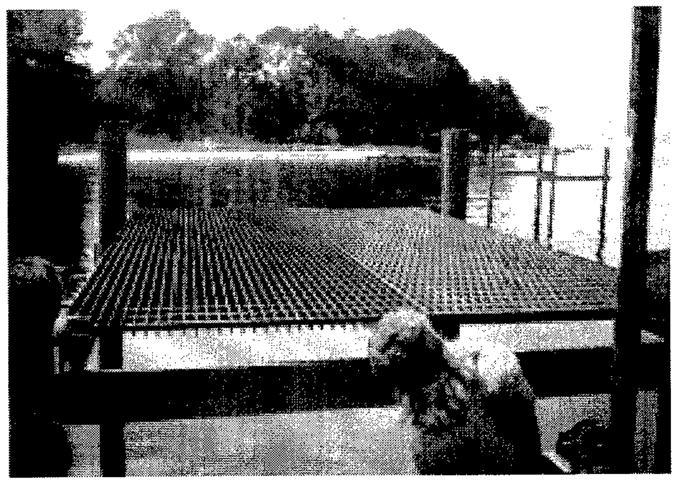

Figure 1. Experimental grid platform

Two experimental fiberglass grid platforms were constructed in late April 1999 in St. Andrew Bay adjacent to St. Andrew State Park in Panama City Beach, FL (Figure 1). The construction of these platforms involved a unique collaborative effort between various federal and state agencies and the private sector. The platforms are located in water depths of approximately 3.5 ft MHW in a relatively continuous bed of the seagrass *Thalassia testudinum*. Dimensions of each platform were approximately 8 ft by 12 ft with the long axis oriented in an east-west direction. The two platforms were constructed at differing heights (4 ft and 5 ft above MHW) to compare the effects of dock height. An initial site survey was performed to determine baseline conditions prior to platform construction. Good water clarity at the site permitted estimates of seagrass percent cover and density using nondestructive visual sampling techniques. To establish baseline conditions, mean seagrass percent cover and shoot density were estimated from a series of plots beneath each platform.

One of the objectives of this study was to demonstrate effective construction techniques to reduce the physical disturbance associated with piling installation. Based on the recommendations of dock construction guidelines used for Ono Island, AL, the following technique was adopted for piling installation during this study. All equipment was transported to the site on a shallow-draft barge. A pilot hole was created by using a 3-in. centrifugal pump run at low rpm and a short, quick insertion of a hand-held 1-½-in.-diam lance. The pile was sharpened to a point with a chain saw and the point then placed in the pilot hole. The pile was then driven to grade with a 350-lb drop hammer. Subsequent measurements of the size of the bare areas surrounding each piling ranged from 13-56 cm. If used with care, this method should reduce the area of seagrasses impacted. Any accumulation of sediments on top of the adjacent seagrasses should be removed to prevent burial of the plants.

Changes in seagrass density and percent cover under the experimental platforms over time (pre- and post-construction) will be monitored. Continuous light measurements in both shaded and unshaded areas will also be recorded. Due to the large storage capacity of below-ground rhizomes, shading effects on the seagrass *Thalassia testudinum* may not be evident for several months. Monitoring for at least one full growing season following construction is needed to

determine the full extent of potential shading effects. This study will provide an opportunity to evaluate the effectiveness of the fiberglass grid panels for minimizing shading impacts to seagrasses. The results of this field demonstration will be presented in a future WRP technical note.

SOURCES OF FIBERGLASS GRATE DECKING: The fiberglass grate panels used in this study are manufactured by SeaSafe (Lafayette, LA; phone: 1-800-326-8842). Panels are available in standard sizes of 3 ft x 10 ft or 4 ft x 12 ft. For safety, an anti-slip texture is integrally molded into the top surface. Similar panels are manufactured by several other companies, including ChemGrate (1-800-527-4043). These panels are typically available from industrial suppliers rather than marine construction material outlets. As demand increases, they will likely become more readily available. The panels are available in a variety of opening sizes and thickness. The manufacturer or local distributor should be consulted to ensure that the load-bearing capacity of the selected product is sufficient to support the intended purpose. Contact the manufacturer(s) for product specifications and a list of regional distributors.

ACKNOWLEDGEMENTS: The construction of the experimental platforms was co-sponsored by the U.S. Army Engineer District, Jacksonville, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service. Three 4-ft by 12-ft fiberglass grid panels used in construction of the experimental platforms were donated by ACR Process Equipment, Inc., in Lake Mary, FL. A local marine contractor (Bob Gorman, Inc.) donated time and labor for platform construction. Public awareness signs attached to each platform were produced at cost by the Bay County Board of County Commissioners.

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> Shafer, D. J., and Lundin, J. (1999). "Design and construction of docks to minimize seagrass impacts," WRP Technical Notes Collection (TN WRP-VN-RS-3.1), U.S. Army Engineer Research and Development Center, Vicksburg, MS. www.wes.army.mil/el/wrp.

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